

ECONOMICS AND RISK FROM LOW LEVEL RADIOACTIVE WASTE*

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THE title of this afternoon's session is Low Level Radioactive Waste: How Does Society Respond? The title is interesting to an economist, in particular the selection of the word "does," as opposed to the word "should." A subtle difference, but to an economist there is an important distinction. A theory on "how" society allocates resources is said to be a "positive" theory.¹ Positive economic theories can often be tested to see if they can predict economic behavior or are consistent with empirical evidence. The question "How *should* society allocate its resources?" is said to be a "normative" question because to answer it requires some criterion or way to evaluate alternative feasible allocations. The choice of a criterion is subjective, and thus open to debate.

We have heard papers in this morning's session which have been positive in the sense that they describe how we are currently handling low level radioactive waste, and normative in the sense that there have been recommendations for alternative policies (i.e., a reallocation of resources). Consider the following conclusions from this morning's papers.

While first-generation disposal sites were deficient... "in no case was there significant exposure of either workers at the sites or people living in the environs."²

The hazards to human health posed by low level radioactive waste are "trivial compared to medical radiation which in turn is dwarfed by the potential deleterious effects of radon."³

The costs of engineering additional safety in the design and operation of low level radioactive waste sites may be excessive. "The cost of saving a life by radon remedial action is far less than by improving low level waste facilities."³

The "...costs of disposing of low level radioactive waste should be an important consideration, especially when these costs may be taken away from other enterprises which also involve the public health and safety..."⁴

"...many factors influence the development of disease. The state of the art in

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medical science or epidemiology is not such that we can predict with certainty whether a person who has been exposed to chemicals will ultimately develop a particular disease or condition.”⁵

An economic analysis of low level radioactive waste might examine several factors including the way such wastes are generated and the substitution and technical possibilities for reducing the amount of waste or level of radioactivity, the public health and environmental costs which these wastes might impose if released into the biosphere, the way individuals perceive these risks and their willingness to pay to have such risk reduced, the costs of private and public actions to reduce environmental health risks, and the cost of remedial action if low level radioactive wastes escape into the biosphere.

All of the above factors are relevant when evaluating public policies. In the limited time available I will focus my discussion on risk perception and the notion of willingness-to-pay for risk reduction.

RISK PERCEPTIONS, RISK PREFERENCES AND THE VALUE OF PUBLIC PROGRAMS TO REDUCE ENVIRONMENTAL RISK

There is a vast literature on the economics of choice under uncertainty. (For a recent, relatively nontechnical article see Machina.⁶) Economists have had a long-standing interest in how people make decisions when the outcomes of those decisions are not known when a decision must be made. Also of interest is the role of markets and institutions in pooling or spreading financial risk. Much of this literature deals with financial risks faced by individual investors or “private” risks to a firm or consumer. By a private or individual risk we mean a situation where a firm or consumer must make a decision which will have unknown future consequences affecting the firm’s profits or consumer’s well being. This might be contrasted to a “public” or collective risk where a large number of individuals must make a decision whose unknown consequences will effect everyone’s well being (but not necessarily to the same extent). My choice of employment, recreational activities, financial investments, diet, and other “lifestyle decisions” will affect the likelihood of my future health and wealth but are unlikely to affect the health or welfare of others outside my family. Public or collective risks, while they may be influenced by private actions, frequently result in collective action in the form of regulation, taxes, subsidies, or provision of certain goods and services. Difficulties arise because individuals may differ with respect to their subjective assessment of the public risk, their preferences toward risk taking, and their ability to take private, self-protective actions. I shall consider each in greater detail, relating these concepts to public policy for low level radioactive waste.

RISK PERCEPTIONS

As noted this morning, it is generally not possible for epidemiologists reliably to estimate the probability that an individual will develop a disease or condition based on some level of exposure to a particular chemical. Individuals must therefore “filter” various pieces of information (from newspapers, magazines, or government brochures) to form a risk assessment. Bayesian statisticians would refer to these as “subjective” priors. How people form and update these prior probabilities is not well understood, but it appears that they use certain “heuristics” that do not follow fundamental rules of logic or probability (for a collection of papers on this subject see Kahneman, Slovic, and Tversky.⁷) In a recent study of risks from radon, Johnson et. al.⁸ examine the effectiveness of six different “information treatments” in communicating the risks of radon to residents of New York. Learning was measured in terms of their improvement in answering basic questions about radon and how accurate they were in advising neighbors about their health risks. As part of the same study, Smith and Desvousges⁹ obtained empirical evidence that households did revise risk assessments to become more consistent with the Environmental Protection Administration’s assessment of health risks. The degree of adjustment depended on the format for conveying information, actual radon levels found within a residence, and other socioeconomic variables. This project is ongoing and will examine the remedial response (action) taken by households at risk. (It was noted that risk assessments were revised downward for many households who received radon readings falling below 4 pCi/l, the EPA’s lowest action level.)

RISK PREFERENCES

Even if individuals share the same subjective probabilities about future financial or health risks, they may differ in their risk preferences, that is, their willingness to accept certain risks. For risky outcomes involving large sums of money or premature death most people tend to be “risk averse.” They are typically willing to pay a premium to reduce the risk of a severe loss. Individuals will differ, however, in their degree of risk aversion and thus in the type of actions they might take or in their willingness to pay for a risk-reducing public program. Even if the scientific community is successful in educating the public and there is a convergence in the risk assessment of alternative disposal techniques for low level radioactive waste, different risk preferences may cause people to disagree over the design and level of safety that should be mandated at disposal sites.

Because public policy is formulated and implemented by politicians and bureaucrats, *their* risk preferences become especially important. While poli-

ticians and bureaucrats may face the same health risks as the public at large, they may face an acute “risk of responsibility” if radioactive waste contaminates the environment. The people responsible for the design and operation of radioactive or toxic waste facilities may desire levels of safety beyond the level deemed appropriate by scientists or even the public at large if they will be held responsible for any accidents. Given that their share of the cost of increased safety is relatively small, we can see how *publicly* operated facilities may be “excessively” safe when analyzed on an “expected-cost-per-death-avoided” basis.

PRIVATE ACTIONS AND THE VALUE OF PUBLIC PROJECTS

The third factor that may generate disagreement over the appropriate standards for low level radioactive waste disposal is that individuals can take private actions that may alter their perception of personal risk and thus their willingness to pay for a particular public program. If I drink and cook with bottled water I may be less willing to pay for an extra margin of safety at the local landfill or disposal site. While “self-protective” actions are typically limited, they can reduce perceived risk. Such actions may be relatively inexpensive (e.g., bottled water if groundwater is contaminated or better indoor ventilation in the case of radon) or they can be fairly expensive (drilling a new well, switching to city water, or changing one’s residence).

A public project or policy, as viewed by a particular individual, may have value if it reduces the perceived probability of an adverse outcome or if it reduces the need to take an expensive private action (see Conrad¹⁰ for the conceptual details). It is also true that the ability to take private self-protective actions will depend on one’s income as well as environmental awareness. Thus, there are ethical issues, not only in the presentation of information,⁸ but in the mix of public and private actions to reduce environmental risk. The actual location of a low level radioactive waste site will raise even more difficult issues of equity and compensation. This is the NIMBY (Not In My Back Yard) problem. Time precludes a discussion of this issue, but for an interesting economic solution to this problem see Kunreuther et. al.¹¹

CONCLUSIONS

Determination of appropriate policy for public or collective risks is made difficult because different people will have different subjective assessments on the likelihood of various health outcomes. Epidemiological data are frequently inadequate statistically to infer risks for different levels of exposure. Even if a convergence of risk assessment is possible, people may differ in

their risk preferences (i.e., their willingness to accept certain financial or health risks). Even public or collective risks might be reduced by private actions. People who are aware of self-protective actions and who can afford to take them may be less willing to support public policies that reduce risks for others.

It would appear, based on the papers presented this morning, that many individuals, politicians, and administrators have subjectively overestimated the health risks from low level radioactive waste. An education campaign, using some of the methods of risk communication employed in the EPA study of household radon, may allow for greater convergence in risk assessment than currently exists.

Even with convergence, however, we can expect that people will differ in the degree of safety desired. Some individuals may truly want super-safe "engineered barriers" and be willing to pay for them. Politicians and local public health administrators may also set stricter standards if they bear the burden of responsibility in the event of an accident. It should be expected, then, that convergence in risk assessment will not necessarily lead to a convergence in action, especially public action.

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